MALACOLOGIA, 1971, 11(1): 217-224

THE CHROMOSOMES OF SOME AUSTRALASIAN PARYPHANTIDAE

Helene M. Laws

South Australian Museum
Adelaide, South Australia

ABSTRACT

Six Australasian members of the family Paryphantidae were studied cytologically, the observed chromosome numbers (n) being as follows: *Paryphanta busbyi* (Gray), 32; *Victaphanta atramentaria* (Shuttleworth), 29; *Rhytida dunniae* (Gray), 32; *Strangesta gawleri* (Brazier), 30; *Strangesta tumidula* Iredale, 30; *Schizoglossa novoseelandica* (Pfeiffer), ca. 32. The mitotic chromosome complement of *Victaphanta atramentaria* showed 17 metacentric pairs, including the 2 largest of the complement, and 12 submetacentric pairs. The proportion of metacentric chromosomes in *V. atramentaria* is similar to that previously observed in *Helix pomatia* but different chromosomes of the complement are metacentric. Both differ from succineid snails in which nearly all chromosome pairs are metacentric and from known basommatophorans in which submetacentrics predominate.

INTRODUCTION

Despite increasing interest in the chromosomes of stylommatophoran snails there are many families, particularly those of southern distribution, which are as yet unsampled cytologically. The Paryphantidae are among these and this report gives, to my knowledge, the first observations of chromosome numbers for the family. Among the other families of the Streptaxacea (as defined by Wenz & Zilch, 1960), chromosome numbers are known for only 2 species of the North American Haplotrematidae; *Haplotrema sportella* has n = 29 (Ford, 1962 in Burch 1965) and *H. vancouverense* n = 30 (Burch, 1965).

The family Paryphantidae is centered in the Indo-Pacific region where members are found in eastern Australia, New Zealand, Indonesia and Melanesia; 2 genera are found in South Africa south of latitute 25° South.

MATERIALS AND METHODS

Species of paryphantid snails which were used in this study are listed in Table 1.

Gonad samples, taken after removal of the protoconch and apical whorls, were either fixed and stained directly in aceto-orcein or stained in aceto-orcein after fixation in acetic-alcohol (1:3 v:v) and storage in 70% ethyl alcohol. After being examined, slides were made permanent by mounting in Euparal after alcohol dehydration. After excision of gonad samples, snails were relaxed and fixed and permanent preparations of the radulae and reproductive systems were made. These will form part of an anatomical study of Australasian paryphantids; they have been placed in the collections of the South Australian Museum and, along with the shells, are kept as vouchers for the cytological observations.

RESULTS

Victaphanta atramentaria showed 29 bivalents at late prophase of the 1st meiotic division of spermatogenesis (Fig. 3). In 1 individual a number of mitotic figures confirmed the meiotic chromosome counts and also gave information concerning the morphology of the chromosomes. Fig. 2 shows the mitotic chromosomes and in Fig. 3 they have been arranged according to size and

TABLE 1. Australasian Species of Paryphantidae used for Chromosome Studies

Species	Locality	S. A. M. * Reg. No.
Paryphanta busbyi (Gray)	Mangamuka Gorge, North Auckland, N. Z.	D. 14939
Victaphanta atramentaria (Shuttleworth)	Labertouche, Victoria, Aust.	D. 14898
Rhytida dunniae (Gray)	Near Kaitaia, North Auckland, N. Z.	D. 14938
Strangesta gawleri (Brazier)	Rapid Bay, South Aust.	D. 14972
Strangesta tumidula Iredale	Section 501, Hundred of Kongorong, South Aust.	D. 14971
Schizoglossa novoseelandica (Pfeiffer)	Inglewood, Taranaki, N. Z.	D. 14970

*South Australian Museum, Adelaide

centromere position.

There has been variation in the use by various authors of terms to describe centromere position. I use *metacentric* to describe medianly constricted chromosomes which appear V-shaped, including chromosomes in which the constriction is so close to the centre that a decision cannot be clearly made as to whether the element is V- or J-shaped. Obviously J-shaped chromosomes I term *submetacentric*, using "submedianly constricted" and "subterminally constricted" to distinguish respectively between elements with the constriction nearer the mid-point of the chromosome and those with it nearer the end. Chromosomes in which the small arm is beyond the resolution of the light microscope are *acrocentric*.

It is clear that among the 10 largest chromosome pairs, 5 have a median constriction and 5 are submetacentric. Nine of the next 13 pairs are metacentric and among the 6 smallest chromosome pairs there are probably 3 with median constrictions; with decreasing chromosome size it becomes increasingly difficult to be certain of centromere position. The 2 largest chromosome pairs are both metacentric.

In both *Strangesta gawleri* and *S. tumidula* the chromosome number, as seen in meiotic figures, is n = 30 (Fig. 4-6). There is also a range of chromosome size but no suitable mitotic material was available for study of the chromosome morphology.

Meiotic divisions in both *Paryphanta busbyi* and *Rhytida dunniae* show a chromosome number of n = 32 (Fig. 7, 8). Similarly, the meiotic number for *Schizoglossa novoseelandica* is probably n = 32; for this species material was very limited and the counts should be regarded as tentative.

DISCUSSION

The results of karyotype analysis by other workers, and the observations described in this paper for *Victaphanta*, are summarized in Table 2. In the heterurethran succineids metacentric or submetacentric chromosomes predomi-

FIG. 1, 2. Spermatogonial mitosis in *Victaphanta atramentaria*. Fig. 1, Mitotic prometaphase, 2n = 58. Fig. 2, Chromosomes of Fig. 1 arranged according to size in 2 series, metacentric pairs on the left and submetacentric on the right. The 10 largest chromosome pairs have been numbered in order of decreasing size.


1
10 μ
1
2
3
4
6
7
9
5
8
10
2

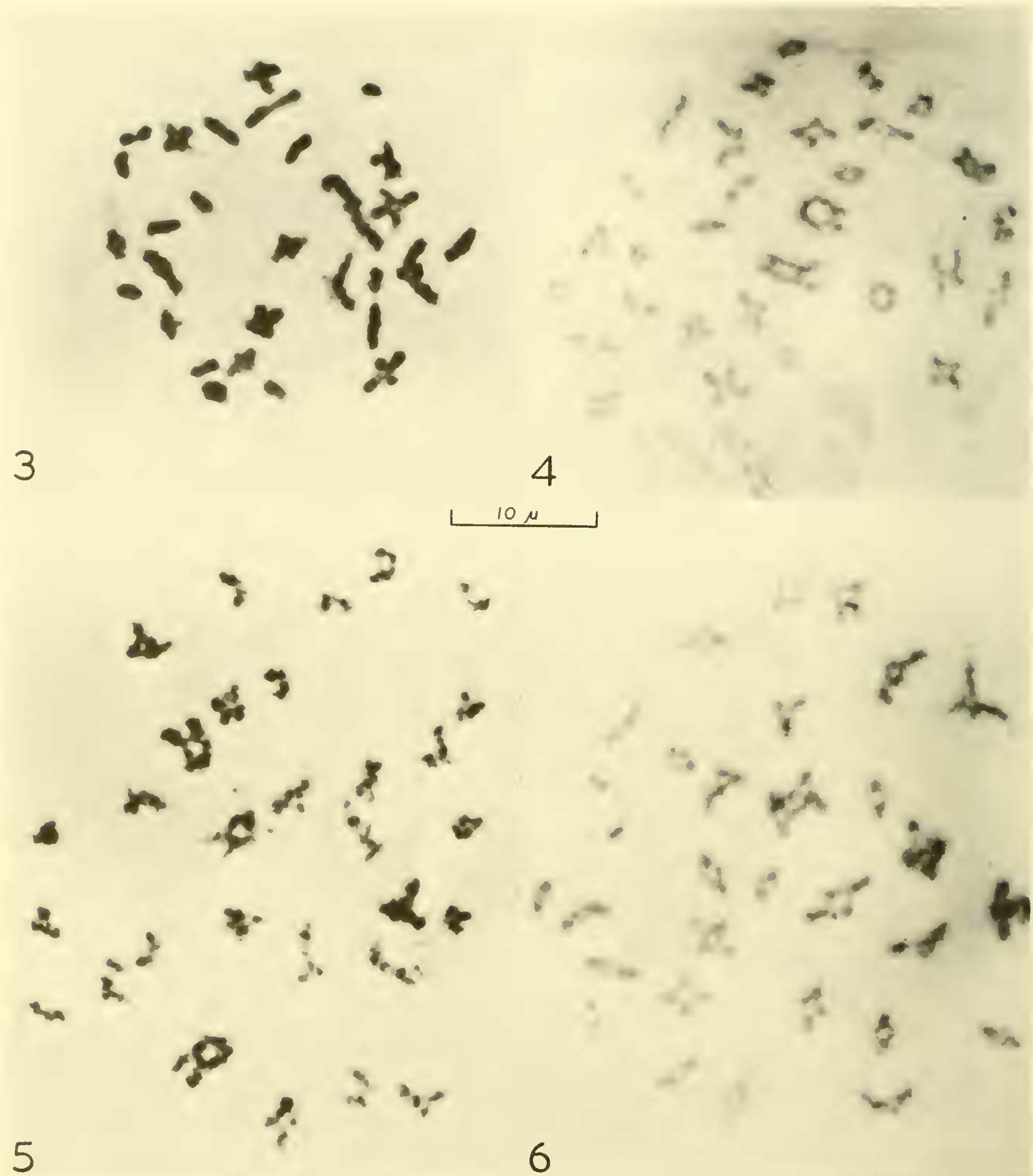

FIG. 3–6. Diakinensis of spermatogenesis in 3 species of Paryphantidae. Fig. 3, *Victaphanta atramentaria*, 29 bivalents. Fig. 4, *Strangesta gawleri*, 30 bivalents. Fig. 5, 6, *Strangesta tumidula*, 30 bivalents.

nate and the largest chromosome pair may fall in either category; in the 2 helicids and *Victaphanta* metacentrics make up a greater proportion of the chromosome complement and the largest pair is metacentric. Superficially, *Helix* resembles *Victaphanta* in that the proportions of metacentric to submetacentric chromosomes are very similar. However, the distribution of the 2 chromosome forms is distinct; among the first 10 chromosome pairs (arranged

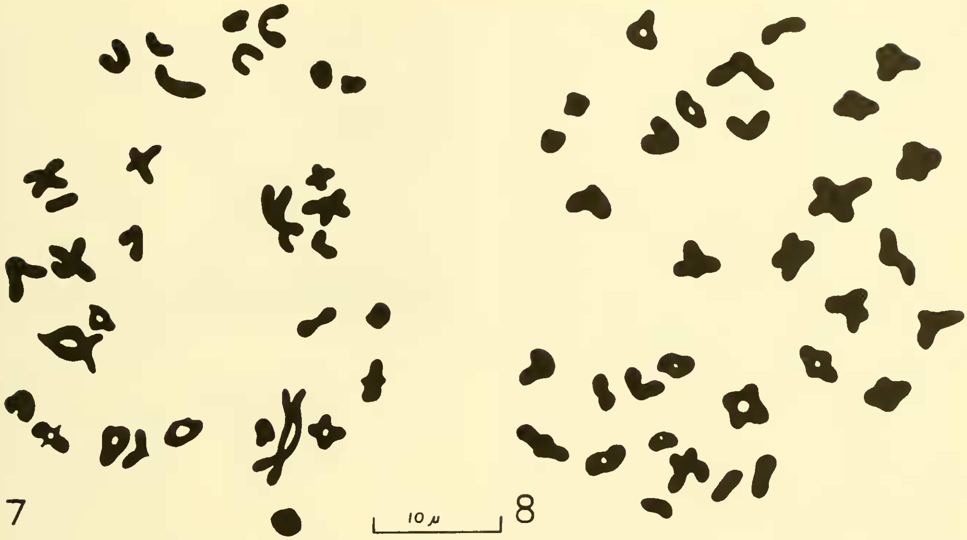

FIG. 7, 8. Diakinensis of spermatogenesis in *Paryphanta busbyi* and *Rhytida dunniae*. Fig. 7, *Paryphanta busbyi*, 32 bivalents. Fig. 8, *Rhytida dunniae*, 32 bivalents.

according to decreasing length) of *Victaphanta* the 3rd to 5th and the 8th and 10th are submedianly constricted, while in *Helix pomatia* the 5th, 9th and 10th are submetacentric. In contrast to the 3 sigmurethran species and to the succineids which show a wide variety of karyotype, the basommatophorans *Melampus bidentatus lineatus* (Ellobiidae), *Acroloxus lacustris* (Acroloxidae) and *Laevapex fuscus* (Ancylidae) have chromosome complements in which submetacentrics predominate (Natarajan & Burch, 1966; Burch, 1962).

The recent development of gonadal tissue culture techniques facilitates karyotype analysis of land snails (Burch, 1968) and mitotic chromosome morphology should in the future provide a useful tool for comparative studies.

The chromosome numbers n = 29, 30 and 32 which are described above for members of the Paryphantidae are comparable to those already found in 2 species of *Haplotrema* (Haplotrematidae), n = 29 and n = 30 (Burch, 1965); these 2 families have been grouped together, along with the Streptaxidae and Chlamydephoridae as the Streptaxacea. As yet, no other members of the group are known cytologically.

The presence of 3 different chromosome numbers among 6 members of the Paryphantidae offers promising possibilities for the use of chromosome numbers in assessing relationships within the family. Such relationships have in the past been determined mainly on conchological evidence (Solem, 1959) although Powell (1930) has shown the usefulness of radular structure in delimiting the New Zealand genera. The few studies of the reproductive system show that it also affords a number of useful taxonomic characters and it is to be hoped that a combined anatomical and cytological approach will help to clarify paryphantid intrafamily relationships.

ACKNOWLEDGEMENTS

I wish to acknowledge assistance from a Nuffield Foundation grant to Dr. A. W. B. Powell and to express my grateful thanks to him for help in collecting *Paryphanta busbyi* and *Rhytida dunniae;* I am also grateful to Dr. B. J. Smith

TABLE 2. The chromosome morphology of pulmonate snails.

Species	Number of chromosome pairs		Largest chromosome pair		Total chromosome number	Source
	metacentric (or almost so)	submetacentric & acrocentric	metacentric	submetacentric	n =	
Acroloxidae						
Acroloxus lacustris	6	12	+		18	Burch, 1962
Ancylidae						
Laevapex fuscus	4	13		+	17	Burch, 1962
Ellobiidae						
Melampus bidentatus lineatus	7	11		+	18	Natarajan & Burch, 1966
Succineidae						
Catinella vermeta	6		+		6	Patterson & Burch, 1966
C. gabbi	6		+		6	Burch, et al., 1966
C. texana	6		+		6	Natarajan et al., 1966
C. arenaria	2	4		+	6	Butot & Kiauta, 1967
C. rotundata	5		+		5	Burch, 1964
Succinea greeri	16	2		+	18	Natarajan et al., 1966
S. hirasei	13	1sm + 3a	-	-	18	Patterson & Burch, 1966
S. urbana	15	3		+	18	Natarajan et al., 1966
S. horticola	12	1sm + 4a	-	-	17	Patterson & Burch, 1966
S. grosvenori	15	4	+		19	Patterson & Burch, 1966
Helicidae						
Helix pomatia	16	11	+		27	Burch, 1968
H. aspersa	11(plus?)	9(plus?)	+		27	Rainer, 1967
Paryphantidae						
Victaphanta atramentaria	17	12	+		29	This report

of the National Museum of Victoria and Mrs. J. Aslin of Mt. Gambier, South Australia for sending specimens of *Victaphanta* and *Strangesta tumidula*, and to Mrs. Sue McGrath for typing assistance.

REFERENCES

BURCH, J. B., 1962, Cytotaxonomic stuies of freshwater limpets (Gastropoda: Basommatophora). I. The European Lake Limpet, *Acroloxus lacustris*. *Malacologia*, 1: 55-72.

BURCH, J. B., 1964, Chromosomes of the succineid snail *Catinella rotundata*. *Occ. Paps. Mus. Zool. Univ. Mich.*, 638: 1-8.

BURCH, J. B., 1965, Chromosome numbers and systematics in euthyneuran snails. *Proc. first Europ. malacol. Congr.*, p 215-241.

BURCH, J. B., 1968, A tissue culture technique for caryotype analyses of pulmonate land snails. *Venus, Jap. J. Malacol.*, 27: 20-27.

BURCH, J. B., PATTERSON, C. M. & NATARAJAN, R., 1966, Chromosomes of four species of North American Succineidae. *Venus, Jap. J. Malacol.*, 24: 342-353.

BUTOT, J. J. M. & KIAUTA, B., 1967, The chromosomes of *Catinella arenaria* (Bouchard-Chantereaux, 1837) with a review of the cytological conditions within the genus *Catinella* and considerations of the phylogenetic position of the Succineoidea ord. nov. (Gastropoda: Euthyneura). *Beaufortia*, 14: 157-164.

NATARAJAN, R. & BURCH, J. B., 1966, Chromosomes of some archaeopulmonata (Mollusca: Basommatophora). *Cytologia*, 31: 109-116.

NATARAJAN, R., HUBRICHT, L. & BURCH, J. B., 1966, Chromosomes of eight species of Succineidae (Gastropoda, Stylommatophora) from the southern United States. *Acta Biol. Hung.*, 17: 105-120.

PATTERSON, C. M. & BURCH, J. B., 1966, The chromosome cycle in the land snail *Catinella vermeta* (Stylommatophora: Succineidae). *Malacologia*, 3: 309-325.

POWELL, A. W. B., 1930, The Paryphantidae of New Zealand: their hypothetical ancestry, with descriptions of new species and a new genus. *Rec. Auckl. Inst. Mus.*, 1: 17-56.

RAINER, J., 1967, Chromosomenuntersuchungen an gastropoden (Stylommatophora). *Malacologia*, 5: 341-373.

SOLEM, A., 1959, Systematics of the land and freshwater mollusca of the New Hebrides. *Fieldiana: Zoology*, 43: 1-238.

WENZ, W. & ZILCH, A. 1959-1960. In *Handbuch der Paläozoologie*. Band 6 (II) Borntraeger, Berlin. xii + 834 p.

ZUSAMMENFASSUNG

DIE CHROMOSOMEN EINIGER AUSTRALASIATISCHER PARYPHANTIDEN

H. M. Laws

Sechs australasiatische Arten der Familie Paryphantiden wurden cytologisch untersucht, folgende Chromosomenzahlen (n) wurden festgestellt: *Paryphanta busbyi* (Gray) 32; *Victaphanta atramentaria* (Shuttleworth) 29; *Rhytida dunniae* (Gray) 32; *Strangesta gawleri* (Brazier) 30; *Strangesta tumidula* Iredale 30; *Schizoglossa novoseelandica* (Pfeiffer) ca. 32. Der diploide Chromosomensatz von *Victaphanta atramentaria* bei der Mitose zeigte 17 metazentrische Paare einschliesslich dier 2 grössten im Satz und 12 submetacentrische Paare. Das Verhältnis der metazentrischen Chromosome der *V. atramentaria* ähnelt dem früher untersuchten der *Helix pomatia*, aber andere Chromosome des Satzes sind metazentrisch. Beide unterscheiden sich von den Succineiden, bei denen fast alle Chromosomensaare metazentrisch sind, und von den bekannten Basommatophoren, bei denen die submetazentrischen vorherrschen.

H. Z.

RÉSUMÉ

LES CHROMOSOMES DE QUELQUES PARYPHANTIDAE D'AUSTRALASIE

H.M. Laws

Six représentants, en Australasie, de la famille des Paryphantidae ont été étudiés cytologiquement, les nombres chromosomiques observés (n) étant les suivants: *Paryphanta busbyi* (Gray), 32; *Victophanta atrementaria* (Shuttleworth), 29: *Rhytida dunniae* (Gray), 32; *Strangesta gawleri* (Brazier), 30; *Strangesta tumidula* Iredale, 30; *Schizoglossa novoseelandica* (Pfeiffer), ca. 32. La garniture chromosomique de mitose de *Victaphanta atramentaria* montre 17 paires métacentriques, y compris les 2 plus grandes de la garniture, et 12 paires submétacentriques. La proportion de chromosomes métacentriques chez *V. atramentaria* est semblable à celle précédemment observée chez *Helix pomatia* mais où ce sont des chromosomes différents de la garniture qui sont métacentriques. Les 2 espèces diffèrent des Succinées, chez lesquelles presque toutes les paires de chromosomes sont métacentriques et des Basommatophores connus chez lesquels les submétacentriques dominent.

A. L.

RESUMEN

LOS CROMOSOMAS DE ALGUNOS PARYPHANTIDAE DE AUSTRALASIA

H. M. Laws

Se estudiaron citologicamente seis miembros de la familia Paryphantidae de Australasia, siendo sus números de cromosomas (n) observados, como sigue: *Paryphanta busbyi* (Gray), 32; *Victaphanta atramentaria* (Shuttleworth), 39; *Rhythida dunniae* (Gray), 32; *Strangesta gawleri* (Brazier), 30; *Strangesta tumidula* Iredale, 30; *Schizoglossa novoseelandica* (Pfeiffer), ca. 32. El complemento mitótico cromosomático de *Victaphanta atramentaria* mostró 17 pares metacéntricos, incluyendo los dos más grandes del complemento, y 12 pares submetacéntricos. La proporción de cromosomas metacéntricos in *V. atramentaria* es similar a la que se observó previamente en *Helix pomatia* pero diferentes cromosomas de el complemento son metacéntricos. Ambos difieren de los caracoles succineidos en los cuales casi todos los cromosomas pares son metacéntricos, y de otros basommatoforos en los que se conoce predominancia de metacéntricos.

J. J. P.

АБСТРАКТ

ХРОМОСОМЫ НЕКОТОРЫХ АВСТРАЛО-АЗИАТСКИХ PARYPHANTIDAE

ЭЛЕН М. ЛОУС

Исследовались цитологически 6 австрало-азиатских представителей семейства Paryphantidae; оказалось, что число хромосом (n) у них было следующее: *Paryphanta busbyi* (Gray) - 32; *Victaphanta atramentaria* (Shuttleworth) - 29; *Rhytida dunniae* (Gray) - 32; *Strangesta gawleri* (Brazier) - 30: *Str. tumidula* Iredale - 30; *Schizoglossa novoseelandica* (Pfeiffer) - около 32. Митотический набор хромосом у *V. atramentaria* состоит из 17 метацентрических пар, включая 2 самые крупные пары набора и 12 субметацентрических пар. Состношение метацентрических хромосом у *V. atramentaria* сходно с тем, которое ранее наблюдалось у *Helix pomatia*, отличаясь тем, что различные хромосомы набора являются метацентрическими. Оба они отличаются от Succineidae, где почти все пары хромосом-метацентрические, и от Basommatophora, у которых преобладают субметацентрические пары.

Z.A.F.